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THE NOMEID GENUS *CUBICEPS* (PISCES) WITH A DESCRIPTION OF A NEW SPECIES

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ABSTRACT

Seven species of *Cubiceps* are recognized, based on dentition, the position of predorsal bones, and meristics. Teeth on the vomer are uniserial in *Cubiceps baxteri* McCulloch, *C. capensis* (Smith), and *C. squamiceps* (Lloyd). There is a broad knobby patch of vomerine teeth in *C. caeruleus* Regan, *C. gracilis* Lowe, and *C. pauciradiatus*. Teeth are absent on the vomer in *C. **paradoxus*** new species. The position of the predorsal bones in *C. caeruleus* and *C. gracilis* is unique among nomeids.

Fishes of the nomeid genus *Cubiceps* are important oceanic fishes in the temperate and tropical oceans. They are routinely found in the stomachs of porpoises (Perrin et al., 1973; Fitch, pers. comm.) and tunas (Alverson, 1963; Legand et al., 1972). Large specimens are occasionally taken on tuna longlines (Abe, 1955) and in the Philippine lift net fishery (Herre and Herald, 1950). A potential fishery may exist off South Africa where a trawler reported taking up to 10 tons in a purse seine (Elizabeth Louw, pers. comm.). Only a few specimens were preserved; the remainder of the catch was dumped for lack of a market.

In spite of the apparent abundance of the species, specimens in museums are few and comparative material has only recently been available. The original descriptions of several species have been inadequate or even misleading. The species are all quite similar, and most have wide distributions. This has led to considerable confusion. Early workers have either described new material as new species, or have assigned new records to the type of the genus. Thus, *C. pauciradiatus* Gunther, a worldwide tropical species, has four junior synonyms from various localities, whereas specimens from around the world have been identified as *C. gracilis* Lowe, a species restricted to the northwestern Atlantic and Mediterranean.

In his revision of the stromateoid fishes Haedrich (1967) defined the genus and gave tentative synonymies for the species. In 1972, working with adult specimens, Haedrich further characterized the genus by the squamation on top of the head. In 1976 Ahlstrom et al. described life histories of five species of *Cubiceps*, two of which were considered as possibly undescribed species. They designated these two kinds as *Cubiceps* sp. A and *Cubiceps* sp. B. Since these species had unusual caudal fin counts, radiographs were obtained of the types of likely nominal species. Study of radiographs of the stuffed holotype of *C. capensis* (Smith) showed clearly that it possessed the high procurrent ray count and meristics characteristic of *Cubiceps* sp. A of Ahlstrom et al. (1976). Additional specimens of this species from off South Africa had a predorsal formula of 0/0/0+2/. This form is quite distinct from the one that Haedrich (1967) had described as *C. capensis*. Radiographs and subsequent study of the two small cotypes of *C. caeruleus* Regan showed that this species has the predorsal formula of 0/0/0/2/, two rather than three anal spines and knobby teeth on the vomer. Hence this is actually the species which Haedrich (1967, 1972) and Ahlstrom et al. (1976) had assigned to *C. capensis*. The problem remained as to which name, if any, applied to the species that had been called *C. caeruleus* by Haedrich (1967, 1972) and by Ahlstrom et al. (1976). A radiograph of the holotype of *C. baxteri* McCulloch

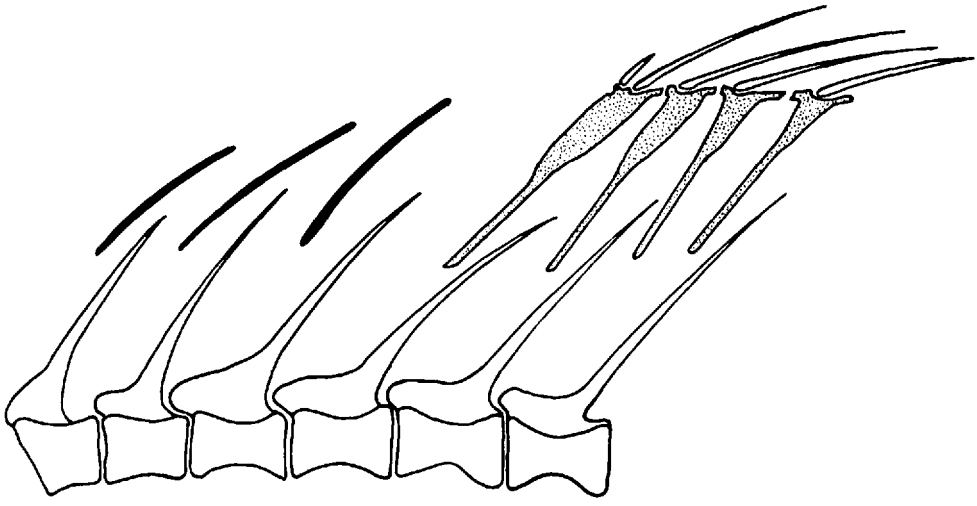

Figure 1. Arrangement of predorsal bones (black), first four dorsal pterygiophores (shaded), and first six neural spines (unshaded) in *Cubiceps caeruleus* and *C. gracilis*.

showed it to be conspecific with *C. caeruleus* of Haedrich (1967, 1972) and Ahlstrom et al. (1976) and that the species should therefore be known as *C. baxteri*.

Hence, based on the findings of this study, the names applied to the several species of *Cubiceps* are markedly changed. Of the five species treated by Ahlstrom et al. (1976), the nomenclature should be revised as follows: *C. caeruleus* = *C. baxteri*, *C. capensis* = *C. caeruleus*, *Cubiceps* sp. A = *C. capensis* and *Cubiceps* sp. B is described as a new species *C. paradoxus*. Only *C. pauciradiatus* remains unchanged.

Materials and Methods

Specimens examined in this study are housed in the following institutions: Australian Museum, Sydney (AM), British Museum—Natural History (BMNH), Institute für Seefischerei, Hamburg (ISH), Natural History Museum of Los Angeles County, Los Angeles (LACM), National Museum, New Zealand (NMNZ), J. L. B. Smith Institute of Ichthyology, Rhodes University (RUSI), South African Museum, Capetown (SAM), Scripps Institution of Oceanography (SIO), National Museum of Natural History, United States (USNM), University of Washington (UW), and Southwest Fisheries Center, National Marine Fisheries Service, La Jolla, California (SFC) (SFC numbers are station numbers, not catalogue numbers).

Measurements are self explanatory. Vertebrae, predorsal bones, dorsal, anal and caudal fin elements were counted from radiographs. The relation of predorsal bones, neural spines, and pterygiophores is expressed as the following formula: predorsal bones are designated as 0, neural spines as /, and the first pterygiophore as 2 (Ahlstrom et al., 1976).

Cubiceps Lowe, 1843

Diagnosis.—Elongate nomeids with scales covering the top of the head almost to the nostrils, origin of dorsal fin over or behind pectoral fin base (Haedrich, 1972), larvae without early developing pelvic fins, and juveniles not conspicuously barred (Ahlstrom et al., 1976). Allometric growth of pectoral fin in several species, the pectoral fin becoming longer in adults. Vomerine, glossohyal and palatine teeth usually present. Predorsal bones in two patterns. One pattern with the first predorsal bone in advance of the first neural spine, the second predorsal between the first and second neural spines, the third predorsal between the second and

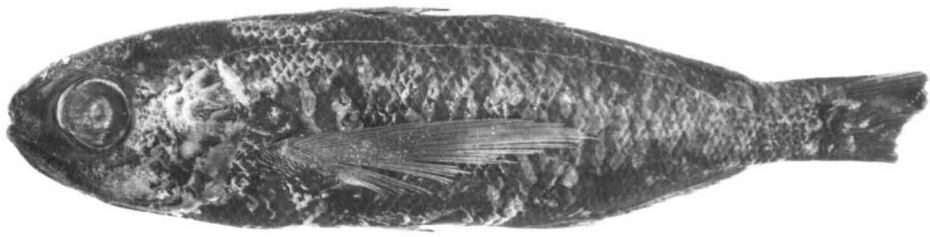

Figure 2. *Cubiceps baxteri*, McCulloch, Lord Howe Island, BMNH 1926, 6.30.50. 276 mm.

third neural spines, and the first pterygiophore between the third and fourth neural spines 0/0/0/2/ (Fig. 1). This pattern is found in *C. baxteri, C. capensis, C. squamiceps, C. pauciradiatus,* and *C. paradoxus,* n. sp.

Artificial Key to the Species of *Cubiceps*

1a. Teeth on vomer in broad knobby patches 2
1b. Teeth on vomer uniserial or lacking 4
2a. Anal spines III, vertebrae 32–34 (33) ..... *Cubiceps gracilis* Lowe 1843
2b. Vertebrae 31, anal spines II 3
3a. Dorsal soft rays 15–17, anal rays 14–16 ..... *Cubiceps pauciradiatus* Günther 1872
3b. Dorsal soft rays 23–27, anal rays 23–24 ..... *Cubiceps caeruleus* Regan 1914
4a. Upper procurrent caudal rays 8–10 5
4b. Upper procurrent caudal rays 11–12 6
5a. Dorsal soft rays 20–23, anal rays 20–22, vertebrae 12 + 19 = 31 ..... *Cubiceps baxteri* McCulloch 1923
5b. Dorsal soft rays 17–20, anal rays 17–19, vertebrae 13 + 18 = 31 ..... *Cubiceps squamiceps* (Lloyd) 1909
6a. Teeth on tongue uniserial ..... *Cubiceps capensis* (Smith) 1849
6b. Teeth on tongue lacking ..... *Cubiceps paradoxus* new species

Cubiceps baxteri McCulloch
(Figure 2)

Cubiceps baxteri McCulloch, 1923, 14: 15, pl. 1. Holotype in Australian Museum.

Cubiceps caeruleus, not of Günther, McCulloch, 1923, 14: 15, pl. 1; Haedrich, 1967, 40, 81 (in part, Lord Howe Island specimen only); Haedrich, 1972, pp. 77–79; Ahlstrom et al., 1976, pp. 339–342.

Cubiceps gracilis, not of Lowe, Abe 1955, pp. 1–5; Smith, 1966, pp. 65–69.

Material.—Australia and Lord Howe Island: AM, Holotype, radiograph only; AM 7585, 1 (418 mm); AM 17598, 1 (415 mm); AM 16150, 1 (283 mm); BMNH 1926, 6.30.50, 1 (276 mm). Eastern tropical Pacific: SIO 77-231, 4 (92–110 mm); SIO 77–227, 3 (79–165 mm); SIO 77-229, 1 (157 mm); SIO 75-257, 4 (110–129 mm); SIO 75-253, 1 (120 mm). South Atlantic: ISH 1391/68, 1 (127 mm); ISH 1449/68, 1 (135 mm).

Additional Material.—An additional 283 specimens in 29 lots from the eastern Pacific were seen.

Diagnosis.—A *Cubiceps* with uniserial vomerine and glossohyaline teeth, 20–23 soft dorsal rays and 19–22 soft anal rays. The pectoral fin is longer than the head in specimens longer than 90 mm SL.

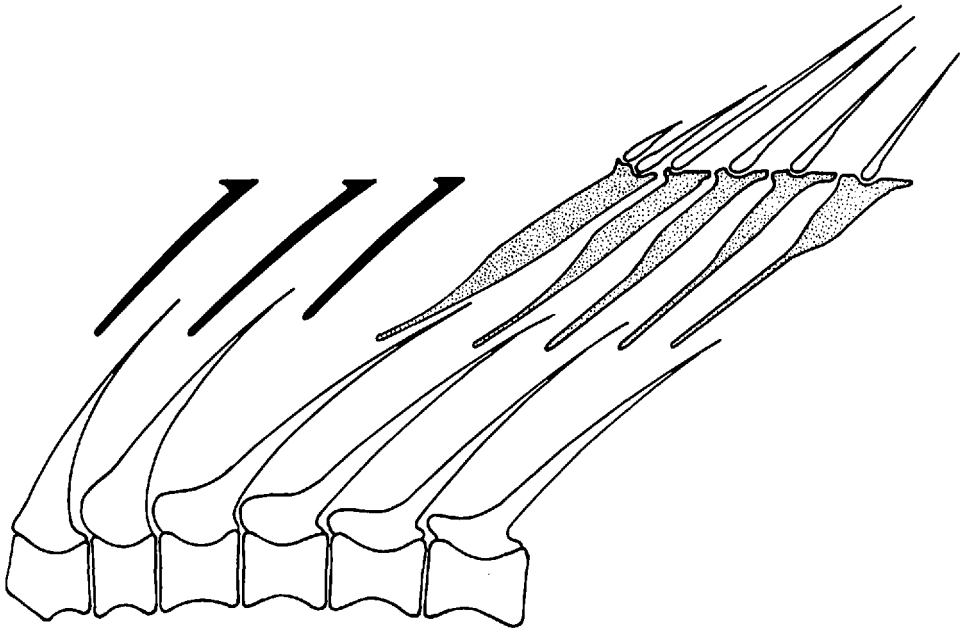

Figure 3. Arrangement of predorsal bones (black), first four dorsal pterygiophores (shaded) and neural spines (unshaded) in *Cubiceps baxteri*, *C. capensis*, *C. squamiceps* and *C. paradoxus* n. sp.

Description.—D XI, I 20–23; A III, 19–22; P 21–23; gill rakers 6–10 + 16–18, total 23–28; lateral line scales 52–66; vertebrae 12 + 19 = 31; upper procurrent caudal rays 7–10; lower procurrent caudal rays 7–10.

Morphometrics are given in Table 1. Body fusiform, moderately compressed. Snout blunt, top of head convex, eye of moderate size, pectoral fin exceeding length of head in specimens longer than 90 mm SL. Origin of dorsal fin slightly behind origin of pectoral fin.

Teeth on vomer, glossohyal and palatines uniserial. Third predorsal bone and first pterygiophore between second and third neural spines (0/0/0 + 2) (Fig. 3).

Color in alcohol, dark brown. Eye blue.

Size.—Specimens over 1 m in length have been reported by Abe (1955).

Remarks.—The lateral line scale count from specimens in the eastern tropical Pacific were lower than counts from specimens from the south Pacific, south Atlantic and western Pacific. In eastern tropical Pacific specimens lateral line scales numbered between 52 and 58, whereas in specimens from the south Atlantic and south Pacific, the lateral line scales numbered about 65. Specimens from the western Pacific reported by Abe also had about 65 lateral line scales. Although these counts are non-overlapping, no other difference of meristics was noted, and morphometrics of the specimens were similar. Larvae from the south central and north central Pacific do not differ from those found in the eastern tropical Pacific. Until specimens of adults from intervening areas are available, I prefer to consider the eastern tropical Pacific population to be a geographical variant of *C. baxteri*.

Identification.—*Cubiceps baxteri* was regarded as a synonym of *C. gracilis* by Smith (1966) and a synonym of *C. caeruleus* by Haedrich (1967). It is distin-

Table 1. Morphometrics of *Cubiceps* with minimum and maximum values and means in parentheses

	baxteri	*caeruleus*	*capensis*	*gracilis*	*pauciradiatus*	*paradoxus*	*squamiceps*
Number of specimens	19	39	2	4	20	1	18
Standard length (mm)	78.7–418.0	28.2–183.4	288–425	94.0–162.0	86.5–128.3	568.0	67.4–148.0
Thousandths of SL							
Head length	297–364 (316)	261–365 (300)	267–293	275–320 (299)	278–332 (310)	296	304–351 (327)
Pectoral fin length	308–434 (367)	188–346 (308)	274–364	251–308 (284)	284–368 (334)	310	252–305 (272)
Pelvic fin length	108–163 (129)	104–154 (120)	169	75–113 (95)	111–143 (125)	90	154–185 (169)
Predorsal distance	321–440 (373)	202–418 (378)	321–380	358–392 (378)	346–395 (376)	354	348–376 (362)
Preanal distance	587–716 (624)	580–679 (643)	570–624	592–634 (614)	657–730 (683)	565	589–664 (638)
Maximum depth	256–351 (300)	249–344 (269)	260–280	228–283 (255)	206–278 (257)	199	292–352 (319)
Least depth caudal peduncle	89–119 (102)	72–96 (80)	89–95	77–99 (87)	87–112 (99)	65	87–106 (100)
Head length (mm)	24.4–127.3	10.3–54.0	76.9–124.6	27.7–45.5	26.0–37.1	168.0	22.8–50.0
Thousandths of head length							
Snout length	226–309 (278)	243–286 (270)	266–299	222–264 (246)	250–340 (285)	323	250–292 (270)
Orbit	254–301 (278)	244–320 (276)	225–252	240–264 (250)	251–320 (282)	185	249–300 (276)
Interorbital width	203–337 (301)	262–320 (290)	247–388	278–290 (285)	257–342 (296)	271	255–333 (310)
Length of upper jaw	236–314 (276)	260–319 (295)	303–345	245–274 (262)	245–318 (268)	200	270–346 (292)

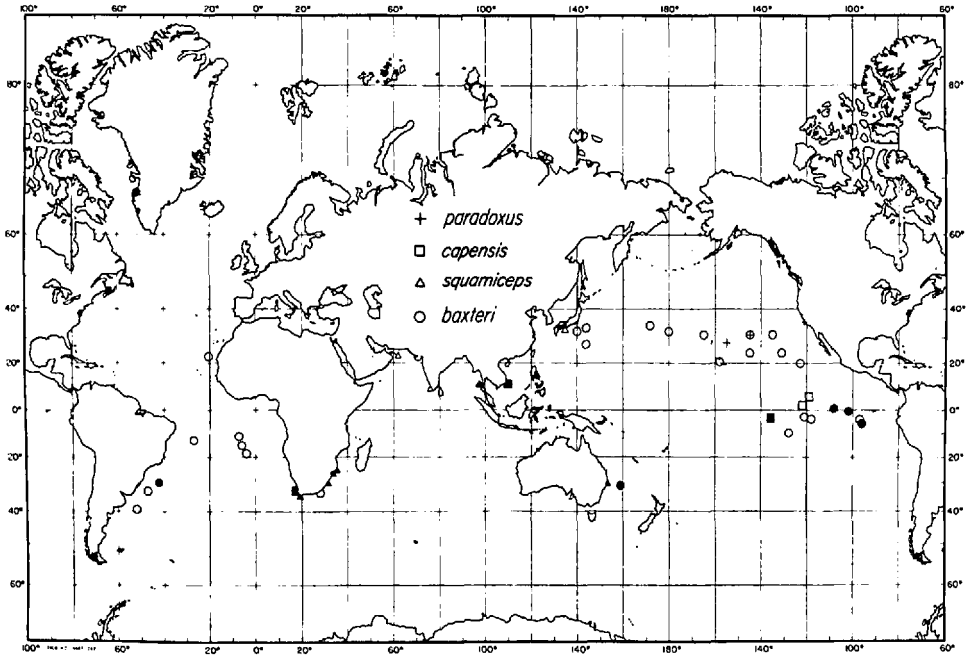

Figure 4. Distribution of *Cubiceps baxteri* (circles), *C. capensis* (squares), *C. squamiceps* (triangles) and *C. paradoxus* n. sp. (crosses). Open symbols represent literature records.

guished from both by the presence of uniserial teeth on the vomer and on the glossohyal. It is most closely related to *C. squamiceps* from which it is distinguished by its higher dorsal and anal counts and longer pectoral fin in adults.

Distribution.—*Cubiceps baxteri* is widespread in the Pacific between 35°N and 35°S (Fig. 4). It is also widespread in the Atlantic from 23°N to 40°S. A single record for the Indian Ocean is that of Smith (1966).

Cubiceps caeruleus Regan
Figure 5

Cubiceps caeruleus Regan 1914a, pp. 15–16; Regan, 1914b, lectotype BMNH 1913.12.6.29: 11–17; Trunov, 1975: pp. 351–360.

Cubiceps capensis, not of Smith, Haedrich, 1967, 135, p. 81 (in part, all non-type material); Craddock and Mead, 1970: 3.33; Haedrich, 1972: 79; Karrer, 1975: pp. 75–77; Ahlstrom et al., 1976: pp. 343–346; Pequeño, 1976: pp. 805–806.

Material.—South Pacific: BMNH 1913.12.6: 28–29. 2 (80–95 mm). Syntypes of *Cubiceps caeruleus* Regan 1914. New Zealand, Three Kings Is.; SIO 63-1008, 1 (14 mm); SIO 72-312, 1 (16 mm); SIO 77-190, 3 (155–178); NMNZ 7360 (same as SIO 77-190), 12 (161–182 mm); USNM 208082, 1 (60 mm); USNM 208086, 1 (89 mm); USNM 208083, 1 (82 mm). South Atlantic and South Africa: BMNH 1930.1.12.1072, 1 (91 mm); ISH 1200/71, 1 (142 mm); ISH 1090/71, 2 (151–162 mm); ISH 764/71, 5 (135–154 mm); USNM 206914, 4 (137–158 mm), same as ISH 764/71; RUSI 3908, 1 (160 mm); SAM 27491, 4 (28–43 mm); SAM 26069, 4 (130–133 mm); SAM 27490, 1 (42 mm); BMNH 1925.10.14.1–4, 4 (157–164 mm).

The following South Atlantic specimens of *C. caeruleus* were collected by the FFS WALTHER HERWIG, but were not available at the time of this study (G. Krefft, in litt.): WALTHER HERWIG Stas. 4-I/76, 1 (133 mm); 4-II/76, 1 (155 mm); 107/76, 1 (135 mm); 109-II/76, 1 (107 mm).

Diagnosis.—A *Cubiceps* with 23–27 dorsal rays, 21–24 anal rays, 2 anal spines,

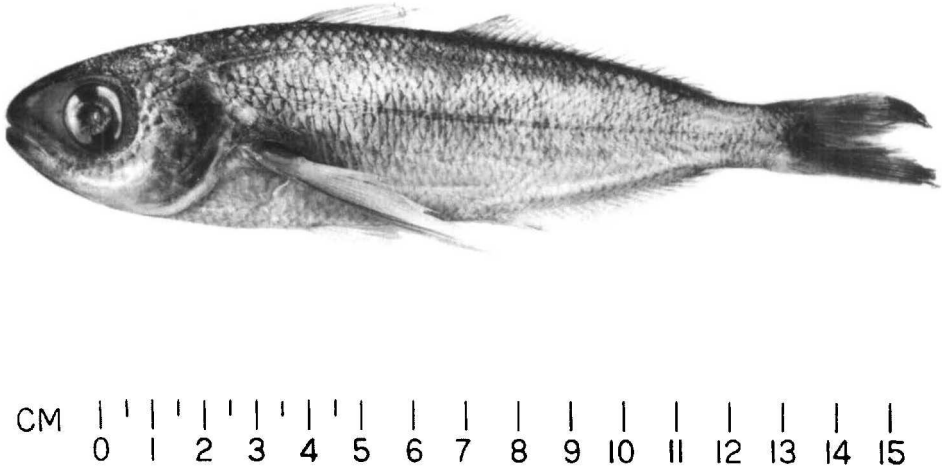

Figure 5. *Cubiceps caeruleus*, Regan, South Atlantic, ISH 764/71. 146 mm.

a broad patch of knobby teeth on the vomer and glossohyal, and only the third predorsal bone between the second and third neural spines.

Description.—D XI, I 23–27; A II, 21–24; P 19–22, gill rakers 6–9 + 17–20, total 23–27; lateral line scales 50–56; vertebrae 12 + 19 = 31; upper procurrent caudal rays 7–9; lower procurrent caudal rays 7–9.

Morphometrics are given in Table 1. Body fusiform, moderately compressed.

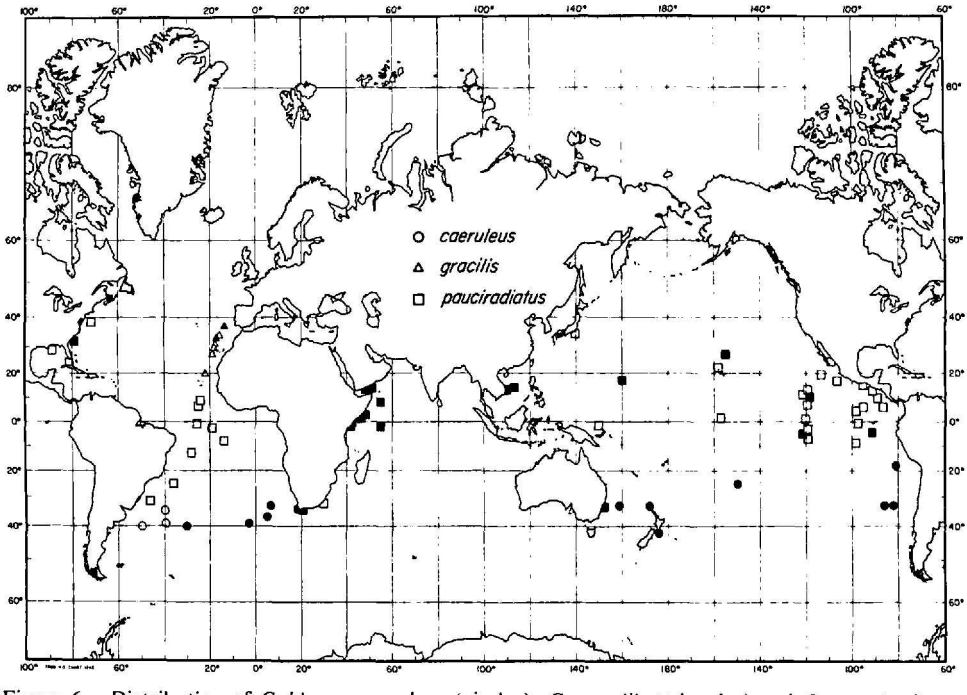

Figure 6. Distribution of *Cubiceps caeruleus* (circles), *C. gracilis* (triangles) and *C. pauciradiatus* (squares). Open symbols represent literature records.

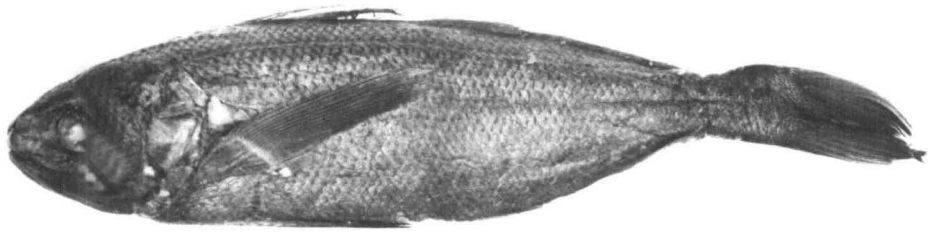

Figure 7. *Cubiceps capensis* (Smith), South Africa, SAM 25537. 288 mm.

Snout rounded, top of head convex, eye of moderate size. Head about 3.3 in standard length. Pectoral fin longer than head in specimens larger than 100 mm SL. Origin of dorsal fin slightly behind pectoral fin base.

Teeth on vomer and glossohyal in a broad knobby patch in specimens larger than 80 mm, uniserial in smaller specimens. About 8 to 10 teeth in a single row on palatines. A neural spine between last predorsal bone and first pterygiophore (0/0/0/2/) (Fig. 2).

Color in alcohol, dark gray with pinkish undertones in some specimens. Unscaled portion of snout bluish. Type specimens are bluish gray.

Size.—The largest specimen (182 mm) is not sexually mature.

Remarks.—A re-examination of the types of *C. caeruleus* Regan indicates several errors in the original description. The dorsal fin count is XI, I, 25 in the larger and XI, I, 24 in the smaller specimen (rather than XI, I, 23). The anal fin count is II, 22 (rather than III, 21) in the larger specimen and uncountable in the smaller specimen although there are definitely only 2 anal spines. The skin is gone, so no lateral line scale count is possible. The pectoral fin has 20 rays in the larger and 21 rays in the smaller specimen. A knobby patch of teeth has formed on the glossohyal and a similar patch is beginning to form on the vomer. The third predorsal bone lies between the second and third neural spine; the first pterygiophore lies between the third and fourth neural spine (0/0/0/2/). The larger cotype, BMNH 1913.12.6.29 is here selected as the lectotype.

Distribution.—*Cubiceps caeruleus* is an antiboreal species (Fig. 6). It is widespread in the Atlantic south of 35°S. In the Pacific it reaches 19°S in the Peru Current. The absence of records from the south Indian Ocean may reflect the paucity of sampling in this region.

Cubiceps capensis (Smith)
Figure 7

Atimostoma capensis Smith 1849, pl. XXIV. Holotype in British Museum.

Cubiceps capensis, Barnard 1948, pp. 389–399, figs. 10–12. Haedrich 1967, 135, p. 81 (in part, the type only).

Cubiceps sp. A, Ahlstrom, Butler and Sumida, 1976, pp. 352–355.

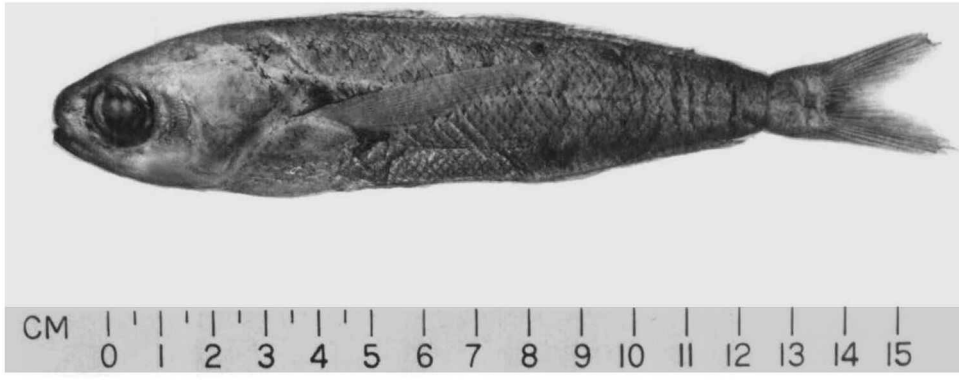

Figure 8. *Cubiceps gracilis*, Lowe, Madeira, BMNH 1863, 12.12.7–8. 142 mm.

Material.—South Africa: BMNH, 1 (905 mm, stuffed), Holotype (radiograph only); SAM 19375, 1 (425 mm); SAM 25537, 1 (288 mm). Pacific Ocean: SIO 61-582, 2 (40–42 mm); SIO 71-80, 1 (19.5 mm); SIO 70-229, 1 (14 mm); SFC, ETP 11.068, 1 (8.7 mm).

Diagnosis.—A *Cubiceps* with 11–12 superior procurrent caudal rays, 10–12 inferior procurrent caudal rays, and uniserial teeth on the vomer.

Description.—D XI, I 20–23; A III, 20–21; P 21–23; gill rakers 7–9 + 16–19, total 23–28; lateral line scales 66–67; vertebrae 12 + 19 = 31; upper procurrent caudal rays 11–12; lower procurrent caudal rays 10–12.

Morphometrics are given in Table 1. Body fusiform, moderately compressed, snout convex, top of head moderately convex, eye of moderate size. Pectoral fin exceeding length of head in large specimens (>200 mm). Origin of dorsal over pectoral fin base. Caudal peduncle short.

Teeth on vomer, glossohyal, and palatines uniserial. Third predorsal bone and first pterygiophore between second and third neural spines (0/0/0 + 2/) (Fig. 3).

Color in alcohol, purplish brown, fins blackish.

Size.—The type specimen (905 mm) is the largest known.

Distribution.—South Africa and tropical Pacific (Fig. 4).

Cubiceps gracilis Lowe
Figure 8

Cubiceps gracilis Lowe, 1843.
Navarchus sulcatus Filippi and Verany, 1859.
Trachelocirrus mediterraneus Doumet, 1863.
Cubiceps lowei Osorio, 1909.
Aphareus obtusirostris Borodin, 1930.

Material.—Atlantic Ocean: BMNH 1863, 12.12.7–8, 2 (142–162 mm); ISH 58166, 2 (94–95).

Diagnosis.—A *Cubiceps* with a broad patch of knobby teeth on the vomer and glossohyal, 32–34 vertebrae and only the third predorsal bone between the second and third neural spine (0/0/0/2/) (Fig. 1).

Description.—D XI, I 21–22; A III, 20–21; P 22–23; gill rakers 7–9 + 17–18, total 24–26; lateral line scales 60–62 (from Haedrich, 1972); vertebrae 13 + 19–21 = 32–34; upper procurrent caudal rays 8–9; lower procurrent caudal rays 9–10.

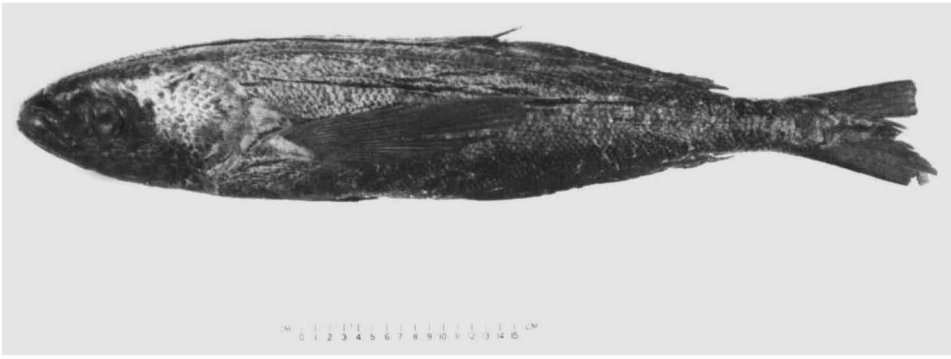

Figure 9. *Cubiceps paradoxus* n. sp. Holotype, Los Angeles, LACM 37048-1. 568 mm.

Morphometrics are given in Table 1. Body elongate, fusiform, tapering from origin of dorsal to tail. Snouth rounded, top of head sloping to dorsal. Eye of moderate size, equal to snout, about 4 in head. Head about 3.5 in SL. Pectoral fin longer than head. Origin of dorsal over pectoral base. Caudal peduncle length equal to depth.

Teeth on vomer and glossohyal in a broad knobby patch. Teeth in both jaws, conical and uniserial. No teeth on palatines.

Color in alcohol, brown.

Size.—Specimens up to 750 mm have been reported by Tortonese (1959).

Distribution.—Mediterranean and northeastern Atlantic (Fig. 6).

Cubiceps paradoxus new species
Figure 9

Cubiceps gracilis? Fitch and Lavenberg 1968, p. 118.
Cubiceps sp. B. Ahlstrom, Butler and Sumida 1976, p. 355.

Material.—Holotype, LACM 37048-1. A 568 mm male. Taken by hook and line off Portuguese Bend, Los Angeles County, California, August 11, 1954.

Additional Pacific Ocean Material.—SFC J7210, 31.145, 1 (12.5 mm); SIO 71-310, 1 (17.9 mm); SIO 72-11, 1 (18.7 mm).

Diagnosis.—A *Cubiceps* lacking teeth on the vomer and glossohyal, with 92 lateral line scales, 11–12 upper and 11–12 lower procurrent caudal rays, and a small mouth and eye.

Description.—D XI, I 19–21; A III, 20–21; P 21; gill rakers 10 + 19 = 29; lateral line scales 92; vertebrae 12 + 19 = 31; upper procurrent caudal rays 11–12; lower procurrent caudal rays 11–12. Hypurals 4, epurals 3.

Morphometrics are given in Table 1. Body elongate, fusiform, slightly compressed. Snout rounded, top of head tapering to dorsal profile, eye small, more than 5 in head. Snout greater than orbit, about 3 in head. Head normal, about 3.3 in SL. Pectoral fin longer than head. Origin of dorsal fin over pectoral fin base. Caudal peduncle long, length about twice depth. Caudal fin forked.

Teeth absent on vomer and glossohyal, uniserial teeth present on palatines. Third predorsal and first dorsal pterygiophore between second and third neural spines (0/0/0 + 2/) (Fig. 3).

Color in alcohol, dark brown.

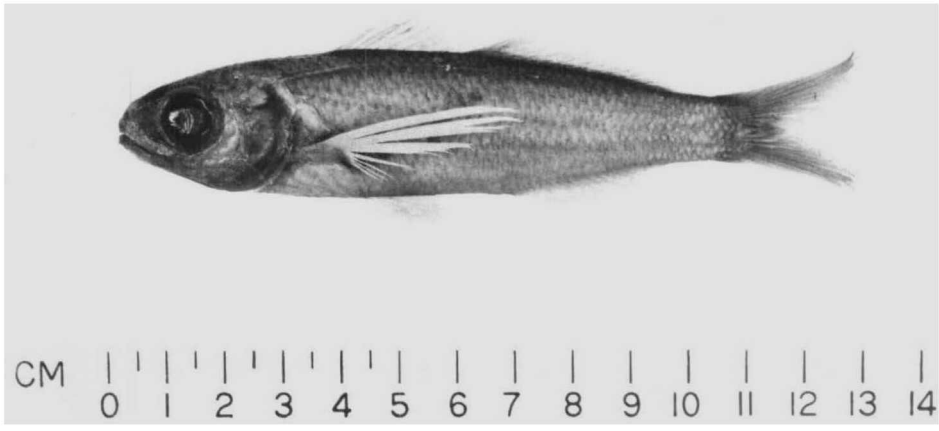

Figure 10. *Cubiceps pauciradiatus*, Günther, Gulf of Aden, USNM 217365. 103 mm.

Size.—The type (568 mm) is the largest known specimen.

Etymology.—From the Latin *paradoxus,* in reference to the absence of teeth on the tongue and vomer, a character which previously was used in part to distinguish *Cubiceps* from *Psenes.*

Distribution.—North Pacific. Three juveniles from the central North Pacific and one adult from California (Fig. 4).

Cubiceps pauciradiatus Günther
Figure 10

Cubiceps pauciradiatus Günther 1872, pp. 418–426.
Cubiceps longimanus Fowler 1934, p. 442, fig. 23.
Cubiceps nesiotes Fowler 1938, pp. 195–196, pl. VIII.
Cubiceps carinatus Nichols and Murphy 1944, pp. 245–247, fig. 4.
Cubiceps athenae Haedrich 1965, pp. 501–505.
Primary synonyms only, for full synonymy see Ahlstrom et al., 1976.

Material.—Indian Ocean: USNM 217365, 1 (103 mm); USNM 217366, 1 (105 mm). Pacific Ocean: SIO 77-238, 3 (99–103 mm); SIO 75-139, 5 (91–101 mm); SIO 77-229, 2 (122–125 mm); SIO 75-103, 5 (105–122 mm); AM 117876-010, 2 (86–105 mm). Atlantic Ocean: SAM 23760, 1 (128 mm).

Additional Material.—Used only for distribution. Atlantic Ocean.—Fred Berry 057-3307.N9, off North Carolina, 1 (7.5 mm). Indian Ocean.—Dodo VI (SIO), Sta. 5, 1 (5.5 mm); Sta. 20, 4 (3.5–7.2 mm); Sta. 22, 3 (6.4–7.8 mm); Sta. 27, 6 (3.5–7.0 mm); Sta. 47, 2 (4.6–6.5 mm); Sta. 64, 2 (5.0–6.1 mm); Sta. 78, 1 (3.5 mm). Pacific Ocean.—SIO 70-103, 1 (8.2 mm); SIO 72-9, 1 (14.2 mm); SIO 61-595, 1 (12 mm); SIO 61-572, 1 (10.5 mm); SIO 61-744, 1 (26.5 mm). An additional 416 specimens in 55 lots from the eastern Pacific were seen.

Diagnosis.—The small number of dorsal and anal rays, the patches of knobby teeth on the vomer and on the glossohyal, the two anal spines, and the bony keel on the brest distinguish this species from all other nomeids.

Description.—D (X)XI, I 15–17; A II, 14–16; P 17–20; gill rakers 7–9 + 16–19, total 22–26; lateral line scales 49–53; vertebrae 12 + 19 (18) = 31 (30); upper procurrent caudal rays 8–10; lower procurrent caudal rays 8–10.

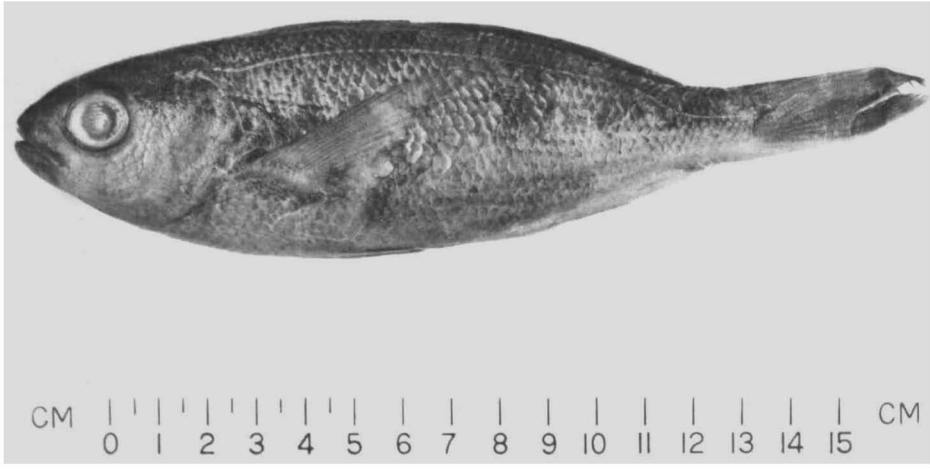

Figure 11. *Cubiceps squamiceps* (Lloyd), New South Wales, AM-I190902. 129 mm.

Morphometrics are given in Table 1. Body fusiform, compressed, snout rounded, top of head convex, eye of moderate size, equal to snout, about 3.3 in head. Head about 3.5 in SL. Pectoral fin longer than head in specimens larger than 90 mm SL. Origin of dorsal fin slightly behind pectoral fin base. Caudal peduncle short, about as long as wide.

Teeth on vomer and glossohyal in a broad knobby patch. Palatine teeth reduced to one or two teeth on each side or absent in some specimens. Both the third predorsal and the first pterygiophore between the second and third neural spines (0/0/0 + 2/) (Fig. 3).

Color in alcohol, brown above, yellowish tan on sides and belly. Fins hyaline.

Size.—This species may not exceed 200 mm in length.

Distribution.—Cosmopolitan in tropical and sub-tropical seas between 40°N and 40°S (Fig. 6). For additional records in the eastern tropical Pacific see Ahlstrom et al. (1976).

Cubiceps squamiceps (Lloyd)
Figure 11

Mulichthys squamiceps Lloyd 1909, pp. 139–180. Holotype in Indian Museum, Calcutta. Kamohara 1952, p. 36.

Cubiceps natalensis Gilchrist and Von Bonde 1923: pp. 7–8, fig. 2, no types designated. Tholasilingam et al., 1964, p. 178, fig. 6. Kamohara, 1952, p. 35.

Cubiceps gracilis, not of Lowe, Herre and Herald 1950, p. 7.

Material.—Philippine Islands: UW 7168, 2 (111–127 mm); UW 7169, 2 (138–144 mm). South Africa: SAM 9991, 1 (67 mm); SAM 26973, 2 (115–138 mm). Australia: AM-I190902, 6 (127–148 mm); AM 15970, 1 (85.5 mm); AM 17874, (73.3 mm); AM 16572, 1 (126.8 mm); AM 17862, 1 (143.2 mm); AM 17884, 1 (137.1 mm). Indian Ocean: IIOE ANTON BRUUN Cruise 1, Sta. 22, 15 (111–123 mm)—radiograph only; IIOE ANTON BRUUN Cruise 8, Sta. 396B, 7 (62–135 mm)—radiograph only.

Diagnosis.—A *Cubiceps* with uniserial teeth on the vomer, 18–19 anal rays, 18–20 pectoral rays and the pectoral fin shorter than the head.

Description.—D (X)XI, I 18–21; A III, 18–20; P 18–20; gill rakers 6–9 + 16–19,

total 23–28; lateral line scales 56–63; vertebrae 13 + 18 (19) = 31 (32); upper procurrent caudal rays 8–9; lower procurrent caudal rays 8–9.

Morphometrics are given in Table 1. Body fusiform, laterally compressed, greatest depth behind pectoral fin base. Snout rounded, top of head sloping to nape. Eye of moderate size, equal to snout about 3.5 in head. Head about 3 in SL. Pectoral fin less than head in specimens 145 mm in SL. Origin of dorsal over insertion of pectoral fin. Origin of pelvics slightly behind pectoral fin base. Caudal peduncle short, length about equal to depth.

Teeth in both jaws, vomer, glossohyal and palatines, conical and uniserial. A few teeth on head of vomer. Third predorsal bone and first pterygiophore between second and third neural spines (0/0/0 + 2/) (Fig. 3). Fine scales on top of head but snout and preorbital space naked.

Color in alcohol, brown shading to tan ventrally, fins dusky.

Distribution.—Indo-West Pacific, South Africa, India, Japan, Philippine Is., and Australia (Fig. 4). All collections have been taken in relatively shallow water. *Cubiceps squamiceps* appears to be a coastal species in an otherwise oceanic genus.

Otoliths

Sagittae of four species of *Cubiceps* were available for this study (Fig. 12). The otoliths of *C. baxteri* and *C. gracilis* are remarkably similar. Both otoliths have a distinct rostrum and a small antirostrum. The ostium is broad and the cauda narrow. The cauda bends ventrally near the posterior end. In *C. baxteri* the antirostrum is more developed, the anterior ventral margin smooth rather than serrate. The ratio of standard length to otolith length is 15.8:1; the ratio of otolith length to height is 1.5:1. The otoliths of *C. gracilis* were illustrated by Chaine (1958). The otolith illustrated here was donated to J. Fitch by C. Karrer. The ratio of standard length to otolith length is 17.4:1 and the ratio of otolith length to height is 1.8:1. The otolith of *C. paradoxus* is quite different from those of the other species. The margins are almost smooth, there is no antirostrum development and the narrow sulcus is nearly straight. The ratio of standard length to otolith length is 19.2:1 and the ratio of otolith length to height is 2.0:1. The otolith of *C. pauciradiatus* is smaller and more oval in outline than otoliths of the other species. The ratio of standard length to otolith length is 21.1:1 and the ratio of otolith length to height is 2.3:1. The posterior dorsal angle is notched. The sulcus is broad and the cauda bends ventrally. An otolith of *C. pauciradiatus* was illustrated from the stomach of the delphinid *Stenella graffmani* = *S. attenuata* as Centrolophidae? by Fitch and Brownell (1968).

Discussion

The presence of teeth on the vomer and palatines has been thought to characterize all nomeids (Haedrich, 1967). However, vomerine teeth are absent in *C. paradoxus* and palatine teeth could not be found in *C. gracilis*. Although this alters the diagnosis of the family it does not indicate that any realignments of, or within, the family are necessary.

Developmental series are known for at least six and probably all seven species of *Cubiceps*. The developmental series of *C. gracilis* was described by Sparta (1946). Ahlstrom et al. (1976) described complete developmental series for *C. pauciradiatus*, and for *C. baxteri* which was then called *C. caeruleus*. Ahlstrom et al. (1976) had a less complete series for *C. caeruleus* (then called *C. capensis*), *Cubiceps* sp. A (presently known to be *C. capensis*), and *Cubiceps* sp. B (herein

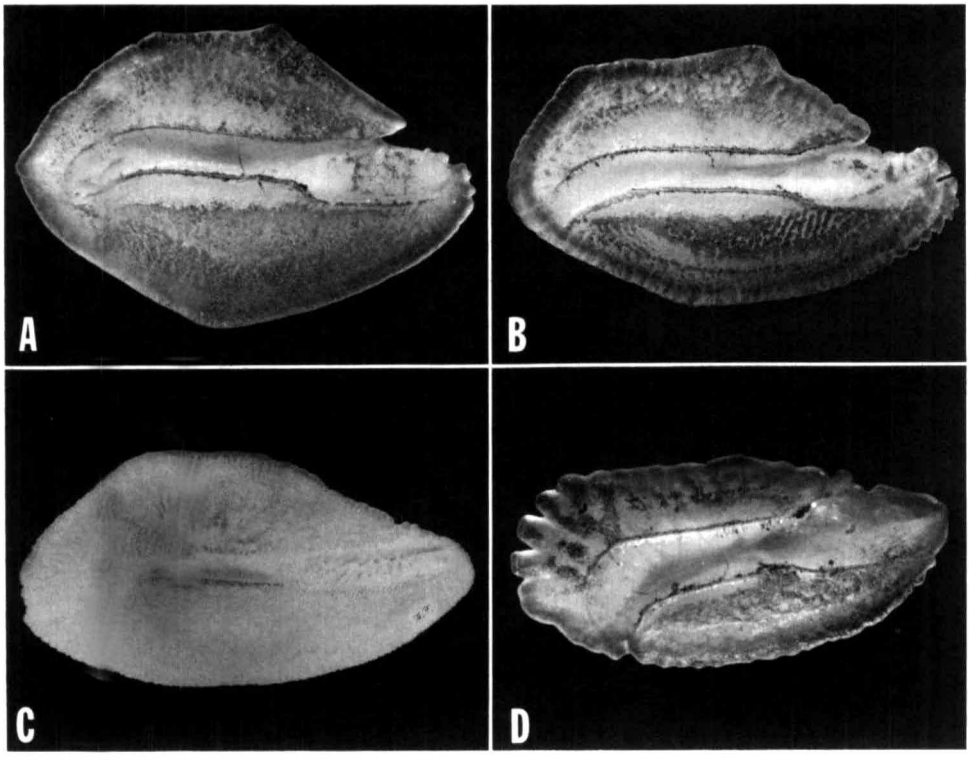

Figure 12. Median views of otoliths, anterior end to the right. A. *Cubiceps baxteri*, SIO 77-227, otolith 10.5 mm, specimen 166 mm; B. *Cubiceps gracilis*, N.W. Africa, otolith 9.3 mm, specimen 162 mm; C. *Cubiceps paradoxus* n. sp. Holotype, otolith 29.5 mm, specimen 568 mm (right otolith, negative reversed); D. *Cubiceps pauciradiatus* SIO 77-227, otolith 5.9 mm, specimen 125 mm.

described as *Cubiceps paradoxus*). Nellen (1973) illustrated an 8.8-mm TL larva of a nomeid, as *Psenes whiteleggii*, which almost certainly is the larva of *Cubiceps squamiceps*.

Trunov (1975) reported specimens of putative *Cubiceps* (designated *Cubiceps* sp.) with knobby teeth on the vomer and scales covering the entire head including the snout. I have not seen any specimens which fit his description. Additional study including vertebral numbers and predorsal bone arrangement is necessary to place these specimens.

Among the species, no clear lineage is evident. The species with knobby vomerine teeth could be considered a derived group with *C. caeruleus* and *C. pauciradiatus*, each having lost one anal spine, the most derived. *Cubiceps gracilis* with knobby vomerine teeth and increased numbers of vertebrae has an otolith remarkably similar to that of *C. baxteri*. Both *C. baxteri* and *C. squamiceps* appear to be central among the species. They have three anal spines and uniserial vomerine teeth. *Cubiceps capensis* is near *C. baxteri* and *C. squamiceps* but shares the high number of procurrent caudal rays with *C. paradoxus*. The loss of vomerine dentition in *C. paradoxus* represents a derivation which parallels that of the arriomids.

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